Sonoma Technology, Inc.
Air Quality Research and Innovative Solutions

Draft
Baldwin Hills Air Quality Study
Work Plan and Quality Control Plan

STI-912024-5424-DWP2

David L. Vaughn
Michael C. McCarthy, Ph.D.
Paul T. Roberts, Ph.D.

Sonoma Technology, Inc.
1455 N. McDowell Blvd., Suite D
Petaluma, CA 94954-6503
Ph 707.665.9900 | F 707.665.9800
sonomatech.com

Richard E. Peltier, Ph.D.
University of Massachusetts

Shane Murphy, Ph.D.
University of Wyoming

Prepared for the
Los Angeles Department of Regional Planning
Los Angeles, California

August 16, 2012

Table of Contents

Section **Page**

List of Figures

Figure **Page**

List of Tables

Table **Page**

1. Introduction

This Draft Work Plan (DWP) and Quality Control Plan has been developed to address two primary project objectives and two secondary project objectives.

- Primary objectives:
  - Quantify the air toxics emissions from the Inglewood Oil Field (referred to as Oil Field throughout this document) operations including drilling and well workovers.
  - Assess the health risk of both acute and chronic exposure to air toxics emissions from Oil Field operations.
- Secondary objectives:
  - To the extent feasible, determine and distinguish the major sources of toxic air emission within the areas surrounding the Oil Field.
  - To the extent feasible, assess the Oil Field's contribution to the overall acute and chronic health risk in the areas surrounding the Oil Field.

As summarized in the Baldwin Hills Community Standard's District Environmental Impact Report (EIR) (Marine Research Specialists, 2008), there are a number of air toxics of concern, including diesel particulate matter (DPM), gaseous volatile organic compounds (VOCs), and trace metals. These different pollutants cannot be measured with a single device, so multiple monitoring and analytical methods are needed. To quantify air toxics emissions from the Oil Field and to assess acute risk from the air toxics of concern, short duration samples are needed. To assess chronic risk, long-term averages that are representative of annual concentrations are needed. Characterizing short- and long-term concentrations across the large number of air toxics emitted from the Oil Field requires that we prioritize the air toxics of greatest concern. We must also account for hourly and seasonal variations in meteorological patterns, which influence the dispersion and transport of Oil Field emissions to the surrounding community. The challenge of requiring multiple measurement methodologies and short sampling durations, while accounting for variable meteorology, is a common but difficult one. The approach and methodologies selected to address this challenge are described in Section 2.

Section 4 discusses the critical monitoring factors of siting, frequency, and duration, and Section 5 discusses the documentation of Oil Field operations. Section 3 lists the project personnel, and Sections 6 through 9 discuss the project's Quality Control and Quality Assurance Plan, data analysis and reporting, the project schedule and milestones, and project management procedures.

It is important to understand that the chosen monitoring plan is driven by concerns of toxics emissions and the associated acute and chronic health risks. Other issues, such as odors, may be more conspicuous but rank lower in terms of potential health impacts.

Much of the language in this Plan is taken directly from STI's original proposal to Los Angeles County, since that proposal contained the contextual information and justification for our monitoring approach. Refinements of the conceptual work plan as it was presented in the proposal have been made, and the additional details, specifications, and justifications supporting those refinements are provided in this document.

2. Approach

Sonoma Technology, Inc.'s (STI) approach to the year-long air quality monitoring program involves

- Hazard identification and dose-response assessment to identify and rank the pollutants of greatest concern
- Selection of the most appropriate monitoring methods, given the available budget, for measuring the pollutants of concern identified in the hazard identification and dose-response assessment and for providing data appropriate to address the study's primary and secondary objectives

2.1 Hazard Identification and Dose Response Assessment

Health risk assessment comprises four component steps, as laid out by the National Research Council and adopted by the California Office of Health Hazard Assessment (OEHHA) (National Research Council, 1983; California Environmental Protection Agency, 2001). The first step is *hazard identification*, which is used to identify pollutants of potential concern and their associated health impacts. The second step is *dose-response assessment*, which provides quantitative benchmark levels for assessing risk. The third step is *exposure assessment*, which involves assessing how people are exposed to the pollutant, for how long, and at what levels. The fourth step is *risk characterization*, in which the three previous steps are synthesized into a quantitative evaluation of a pollutant's potential to cause illness or disease in the population.

To support the development of this work plan, STI evaluated the potential toxicities of pollutants of concern by performing the hazard identification and dose-response assessment steps of the health risk assessment protocol. This toxicity ranking allows us to prioritize among the pollutants emitted by the Oil Field to focus on the pollutants of most concern. For the hazard identification, STI used the reported emissions from 2005 and 2006 used in the Baldwin Hills Community Standards District EIR (Marine Research Specialists, 2008). The EIR provides a list of all toxic air contaminant emissions in pounds per year reported to the South Coast Air Quality Management District (SCAQMD).

STI used these emissions values to compare the pollutants' relative toxicities by weighting these emissions in relation to acute and chronic health benchmark levels from OEHHA. Chronic cancer potency risk factors were obtained from http://www.oehha.ca.gov/air/hot_spots/tsd052909.html, and chronic and acute Reference Exposure Levels (RELs) were obtained from http://www.oehha.ca.gov/air/allrels.html. Acute RELs can be either 1-hr, 8-hr, or 24-hr values; the lowest REL was chosen to provide a conservative estimate of acute toxicities. From this weighting of emissions rates, the pollutants were rank-ordered to prioritize the list. **Table 2-1** shows the final result from this weighting scheme, with the top 13 pollutants listed. The weighted emissions results are normalized so that the most toxic pollutant in a category is scored as 1.0 and all other pollutants are shown in relation to that value. Values below 0.005 are rounded down and not shown, as contributions of less than 1% in relation to the key pollutant in a category are considered negligible for prioritizing pollutants to measure in this study.

Table 2-1. List of key pollutants and their relative toxicities based on the 2005-2006 EIR emissions and OEHHA health benchmark levels.

Pollutant	Total Lb/Year	Fraction from Drilling and Well Workovers	Cancer 1-in-a-Million Level (µg/m³)	Acute REL (µg/m³)	Chronic REL (µg/m³)	Cancer Risk Relative to DPM	Chronic REL Relative to Nickel	Acute REL Relative to Formaldehyde	Cancer Rank	Chronic REL Rank	Acute REL Rank
Diesel Exhaust PM	1326.8	0.99	3.3E-03	–	5	1.00	0.86	–	1	2	–
Cadmium	4.8	1.00	2.4E-04	–	0.02	0.05	0.78	–	2	3	–
Formaldehyde	547.9	0.76	1.7E-01	9	9	0.01	0.20	1.00	5	6	1
Nickel	15.3	1.00	3.8E-03	6	0.05	0.01	1.00	0.04	4	1	6
Chlorine	41.6	1.00	–	210	0.2	–	0.67	0.00	–	4	9
Manganese	4.8	1.00	–	0.17	0.09	–	0.17	0.46	–	7	2
Mercury	3.6	1.00	–	0.6	0.03	–	0.39	0.10	–	5	3
Acrolein	14.7	0.70	–	2.5	0.35	–	0.14	0.10	–	8	4
Lead	5.1	1.00	8.3E-02	–	0.15	0.00	0.11	–	–	10	–
Arsenic	0.6	1.00	3.0E-04	0.2	0.015	0.00	0.13	0.05	6	9	5
Benzene	340.9	0.17	3.4E-02	1300	60	0.02	0.02	0.00	3	11	8
PAHs	16.9	0.79	9.1E-05	–	–	0.00	–	–	7	–	–
Acetaldehyde	215.9	0.96	3.7E-01	470	140	0.00	0.01	0.01	8	12	7

PM: Particulate matter
PAHs: Polycyclic aromatic hydrocarbons

For chronic cancer risk, DPM from the diesel generators is the most significant pollutant. This is consistent with the findings from the Multiple Air Toxics Exposure Study III (MATES III), conducted by SCAQMD, which found DPM (based on proxy measurements of elemental carbon) to be the most important toxic pollutant contributing to risk in the Los Angeles basin (South Coast Air Quality Management District, 2008). In our analysis, the only other pollutants with cancer risks of 1% or more of the risk from DPM were cadmium (5%), benzene (2%), nickel (1%), and formaldehyde (1%). The cumulative risk from emissions of all other pollutants was approximately 10% of the estimated risk from emissions of DPM.

For chronic noncancer risks, many pollutants were of similar importance. Nickel presented the highest risk, followed by DPM (86% of nickel), cadmium (78%), chlorine (67%), mercury (39%), formaldehyde (20%), manganese (17%), acrolein (14%), arsenic (13%), and lead (11%). These noncancer risks can be reproductive, respiratory, or neurological, or they may involve a host of other effects. The similar ranking across pollutants indicates that there is no single driver of chronic health impacts based on the emissions and that a number of pollutants may be important to monitor.

For acute noncancer risks, formaldehyde was the most important pollutant, followed by manganese (46% of formaldehyde). Mercury (10%), acrolein (10%), arsenic (5%), and nickel (4%) were also on the list but are of less importance. Acute effects occur on time scales shorter than one day.

The comparison of emissions from the 2005-2006 inventory shows that the key pollutant to measure from a toxicity standpoint is DPM. Unfortunately, no direct measurement method of DPM is possible (as discussed by MATES III), so a proxy will be used to estimate DPM concentrations. After DPM, the key pollutants to measure include nickel, cadmium, benzene, formaldehyde, manganese, arsenic, acrolein, and mercury. However, the chemical and physical characteristics of these different pollutants require multiple measurement methodologies. Key pollutants other than DPM can be categorized as metals (nickel, arsenic, lead, manganese, cadmium), hydrocarbons (benzene), and carbonyls (formaldehyde, acrolein). The results of the hazard identification and dose-response assessment drive our study methodology choices to focus on the key pollutants of concern from a health standpoint.

2.2 Choice of Monitoring Methods

While 37 known toxic air contaminants are emitted from the Oil Field, the health risks are driven by only a few pollutants. Key among all pollutants for health risk is DPM. Other key pollutant groups for health risk are metals, hydrocarbons, and carbonyls. For these pollutants, it is necessary to (1) characterize emissions from the Oil Field operations and drilling and (2) assess the health risk from the emissions. In order to meet both of these goals, multiple measurement methodologies are necessary to characterize the different pollutant groups. The STI team selected a monitoring approach that prioritizes meeting both objectives for the pollutants of highest concern and also provides estimates of risk for pollutants that appear to be of lower general concern. Our approach also considers the confounding factor of multiple external emissions of the pollutants of concern—including emissions from LAX; emissions from roadways such as I-10, I-405, and La Cienega Blvd.; and residential or commercial emissions—that impact areas surrounding the Oil Field.

Frequently, there is more than one available method for monitoring a given pollutant. For example, both time-integrated sampling (e.g., 24-hr or multiple day filter-based sampling) and continuous methods can be used for many air toxics. Additionally, some pollutants are best measured by using surrogate species that are highly correlated with the target species. Selection of a monitoring method for a given toxic is determined by a cost-benefit evaluation and pertinence to study objectives.

Due to budgetary constraints, STI was forced to prioritize the pollutants for which monitoring could take place at high temporal resolution and to propose less than a full year of monitoring for some toxics. While a year-long monitoring campaign is standard for performing a chronic risk assessment, the climatology of the Los Angeles basin is such that a full year of monitoring is not necessary. Los Angeles is temperate year-round with only a few weeks of rainy conditions. It is possible to adequately characterize concentrations over a shorter representative time period and extrapolate them to values representative of chronic concern.

The STI team will characterize the emissions and health risk from the Baldwin Hills area by measuring (1) black carbon (BC) as a surrogate for DPM at four sites for one year, (2) metals at two sites over two months, and (3) volatile organic compounds and carbonyls during a two-week period at one or two sites. We will also collect wind and other meteorological data for one year at one site.

2.2.1 Black Carbon

STI will use four Aethalometer instruments (Teledyne-API Model 633) to continuously measure BC as a proxy for DPM over the course of one year. BC is a widely accepted surrogate for the monitoring of aggregate DPM. Aethalometers provide real-time information on concentrations of BC and can be correlated with meteorological measurements of wind direction and wind speed to identify emissions from the Oil Field operations and emissions originating from other ubiquitous sources of BC in the surrounding communities. Data from methods that rely on filter samples integrated over a longer time period (such as 24 hours) are not always useful for determining emissions sources, because wind direction typically varies during a 24-hour period.

The API Model 633 Aethalometers will be deployed in enclosures at four sites (see Section 4). The Aethalometers measure the light transmittance through a collection spot on a reel-to-reel filter tape and report data at 5-minute intervals. The aerosol is collected on an area of quartz fiber filter at a moderate face velocity. The sample air stream is drawn through the filter by a continuously operating pump. The optical attenuation of the aerosol deposit on the filter is measured by detecting the intensity of light transmitted through the spot on the filter.

It is important to understand the spatial and temporal variations in BC concentrations as a function of meteorological conditions, especially wind direction. For example, we have learned in past studies that DPM concentrations can vary substantially between weekdays and weekends/holidays because vehicle activity and industrial activity levels (e.g., traffic density and work schedules) change. Similarly, seasonal variability in BC has been demonstrated at many locations. Monitoring protocols must provide data that represent this variability, as well as the range of meteorology that overlays the differing activity levels and seasons. One year of continuous BC data at four sites will be adequate to represent seasonal variability in DPM concentrations as well as differences owing to workday/non-workday schedules and upwind/downwind differences under various meteorological conditions.

2.2.2 Metals

The STI team will deploy a real-time metals instrument, the XACT 625 semi-continuous X-ray fluorescence spectrometer, to measure 24 metals for a period of approximately two months. This instrument is costly to operate, so the monitoring plan for metals focuses on a few key months instead of an entire year. This tradeoff is viewed as a viable alternative to longer-term 24-hr filter-based sampling and is expected to reveal more detailed information on the contribution of the Oil Field to this group of elements, which rank high among the list of air toxics possessing significant health risks. The XACT instrument can make measurements at durations ranging from 15 minutes to 4 hours; for this study we expect to collect at one-hour resolution. Metals measurements from this instrument will also be compared with wind direction and speed to characterize sources of metals emissions from the Oil Field and surrounding communities. Unique chemical fingerprints will be used as a means of identifying specific emissions sources. For example, we may expect nickel and vanadium to be correlated with burning of oil, while zinc would be more characteristic of brake-pad linings. We expect the metal emissions from the oil field to be associated with drilling and well-workovers, as well as fugitive dust emissions from operational activities that disturb the soil.

The STI team will deploy the University of Massachusetts (UMass) XACT 625 semi-continuous X-Ray Fluorescence (XRF) spectrometer for approximately two months to support this investigation. The XACT instrument will be installed in a secure, temperature-controlled facility that includes standard rack-mount instrument housing capabilities.

The XACT 625 automated multi-metals monitor is based on reel-to-reel filter tape sampling followed by nondestructive XRF analysis of metals in the resulting particulate matter (PM) deposit (Yadav et al., 2009; Caudill, 2012). The XACT can simultaneously measure up to 24 elements with an atomic number between potassium and uranium. Ambient air is sampled through a PM size-selective inlet and drawn through a filter tape. The resulting PM deposit is then automatically advanced and analyzed by XRF for selected metals while the next sample is being collected. Sampling and analysis is performed continuously and simultaneously, except for the time required to advance the tape (about 20 seconds) and the time required for daily automated quality assurance checks. Typical sampling and analysis times range between fifteen minutes and four hours; for this project, we will collect hourly samples, which will provide adequate assessment of diurnal profiles and trajectory-specific enhancements without compromising instrument sensitivity.

The instrument determines metal concentrations through two basic functions: (1) measuring the volume of air for the sample collected, and (2) measuring the mass of metals in the sample collected. In the XACT 625, aerosol is drawn into a sampling and analysis module and through a filter tape that collects particulate-phase metals. The air volume of the sample flow is simultaneously measured with a flow meter. Following sampling, the resulting filter tape deposit is advanced to a position where it is analyzed for metal mass using XRF. The X-ray method is consistent with EPA Method IO 3.3, *Determination of Metals in Ambient PM using XRF* (U.S. Environmental Protection Agency, 1999), and three energy levels are used to quantify the sample for the range of analytes. The instrument then determines metal concentrations by dividing the XRF-determined mass. Concentrations of measured elements are reported immediately after analysis and are automatically recorded by an on-board controller, which will be polled remotely.

For this project, we will measure the elements outlined in **Table 2-2**. This encompasses many of the metals thought to be present in the study location, as well as other metals that can be used to identify emissions signatures of other sources that might impact the monitoring site.

Table 2-2. List of elements to be measured in this study. LOD is Limit of Detection given in nanograms per cubic meter at standard temperature and pressure, assuming an hourly sample collection and analysis period.

Element	Atomic Weight	LOD	Element	Atomic Weight	LOD	Element	Atomic Weight	LOD
Sulfur	16	3.7	Iron	26	0.759	Bromine	35	0.185
Potassium	19	0.837	Cobalt	27	0.317	Rubidium	37	0.344
Calcium	20	0.319	Nickel	28	0.226	Strontium	38	0.447
Scandium	21	0.55	Copper	29	0.267	Silver	47	4.37
Titanium	22	0.38	Zinc	30	0.231	Cadmium	48	5.748
Vanadium	23	0.29	Germanium	32	0.121	Barium	56	0.945
Chromium	24	0.288	Arsenic	33	0.114	Mercury	80	0.189
Manganese	25	0.283	Selenium	34	0.141	Lead	82	0.218

2.2.3 Volatile Organic Compounds and Carbonyls

As with the metals, VOC and carbonyl sampling can be accomplished with either continuous monitors or by longer-term filter-based sampling. While VOCs are on the list of air toxics of concern, a preliminary analysis suggests that they are less important than DPM and metals, with benzene, formaldehyde, acetaldehyde, and acrolein being the primary VOCs of interest. STI recommends the measurement of a wide range of VOCs and carbonyls with Proton Transfer Reaction Time of Flight Mass Spectrometry (PTR-TOFMS), as PTR-TOFMS offers low detection limits and high time resolution for the key species of interest for this study. The PTR-TOFMS is owned by Professor Shane Murphy at the University of Wyoming (UWYO). The PTR-TOFMS will provide high-time resolution data parallel to that obtained by the Aethalometer and the XRF spectrometer, but budget constraints limit this option to two weeks of field study time. Alternatively, as originally proposed, deployment of passive samplers for BTEX (benzene, toluene, ethylbenzene, and xylenes) and for carbonyls (formaldehyde and acetaldehyde) at one-week durations would capture spatial gradients in concentrations of these pollutants around the Oil Field and in the surrounding communities. Both approaches have advantages and disadvantages for meeting the monitoring objectives. The total budget allocated for either approach is the same.

PTR-TOFMS Continuous Measurements Option

In this recommended option, the STI team will deploy the UWYO PTR-TOFMS, to measure VOC pollutants for a period of approximately two weeks. This instrument is costly to operate and requires skilled operators, so the monitoring plan for VOCs focuses on a few weeks instead of an entire year. This tradeoff is viewed as a viable alternative to week-long passive sampling and is expected to reveal more detailed information on the contribution of the Oil Field to the key pollutants which rank high among the list of air toxics possessing significant health risks, including benzene, formaldehyde, acetaldehyde, acrolein, 1,3-butadiene, gas-phase naphthalene, toluene, and xylenes. The PTR-TOFMS instrument can make measurements at 1-second intervals; for this study we expect to average this data at resolutions of about 5 minutes. VOC measurements from this instrument will also be compared with wind direction and speed to characterize sources of emissions from the Inglewood Oil Field and surrounding communities. Unique chemical fingerprints will be used as a means of identifying specific emissions sources. For example, we may expect high concentrations of benzene to be correlated with emissions from the oil field, while formaldehyde and acrolein may be associated with diesel emissions and secondary photochemistry.

The STI team will deploy the UWYO PTR-TOFMS for approximately two weeks to support this investigation. The instrument will be transported and installed in a secure, temperature-controlled mobile monitoring van that includes standard rack-mount instrument housing capabilities. We anticipate deploying this instrument during the spring or early summer, depending on oil field operations and expected VOC concentrations and wind conditions.

The Ionicon PTR-TOFMS 8000 is based on whole air sampling through a standard Teflon inlet tube followed by ionization of analytes by proton transfer from H_3O^+ to all compounds with a higher proton affinity than water (Jordan et al., 2009). This includes aromatics, most alkenes, aldehydes, ketones, and some longer chain alkanes. Common constituents of air such as CO, Ar, N_2, O_2, and CO_2 have lower proton affinities than water and are therefore not ionized. Ionization occurs within a drift tube and is “soft” causing minimal fragmentation of parent molecules. After ionization, molecular ions are pulsed into a time-of-flight mass spectrometer capable of measuring the mass of the parent ion at a resolution of 5000 $m/\Delta m$ (0.02 mass units at a mass of 100 atomic mass units). The PTR-TOFMS can simultaneously measure dozens of compounds. Sampling and analysis is performed continuously except for the time required for intermittent background checks and calibrations. Backgrounds are conducted by passing ambient air through a catalytic converter removing all VOCs, and calibrations are done by sending a commercial calibration mixture of aromatic compounds to the instrument at various dilution ratios. For this project, we will collect five-minute samples, which will provide adequate assessment of diurnal profiles and trajectory-specific enhancements without compromising instrument sensitivity. Expected detection limits for most compounds are on the order of 10-100 pptv (parts per trillion by volume), which are well below average concentrations observed in the Los Angeles air basin for the key air toxics. Additionally, a few canisters of Oil Field air samples will be collected during the 2-week monitoring period that will be analyzed by GC-FID and GC-MS (TO-15), giving us independent confirmation of the concentrations measured by the PTR-TOFMS. It should be noted that although some isomeric compounds such as ethylbenzene and the xylenes will not be distinguishable, they can be measured as a sum of species.

One key compound to which the instrument is semi-sensitive is formaldehyde. Formaldehyde has a proton affinity that is just slightly greater than that of water. As a result, formaldehyde concentrations can be sensitive to variations in humidity; however, we do not anticipate much variability in relative humidity during the spring/summer months, as this is well past the typical rainy season.

Table 2-3 outlines the pollutants to be measured. This list encompasses many of the VOCs thought to be present in the study location, as well as other VOCs that can be used to identify emissions signatures of other sources that might impact the monitoring site.

Table 2-3. List of pollutants to be measured during this study and their typical sources.

Compound	Sources
Formaldehyde	Photo-oxidation, vehicle emissions, diesel generators
Acetaldehyde	Photo-oxidation, vehicle emissions, diesel generators
Acrolein	Butadiene photo-oxidation, vehicle emissions, diesel generators
Benzene	Vehicle emissions, oil and gas extraction, gas stations, industrial
Toluene	Vehicle emissions, oil and gas extraction, gas stations, industrial
Xylenes and ethylbenzene (isomers)	Vehicle emissions, oil and gas extraction, gas stations, industrial
1,3-Butadiene	Vehicle emissions, industrial, diesel generators
Methyl ethyl ketone	Photo-oxidation
Decane	Vehicle emissions
Naphthalene	Vehicle emissions
Trimethylbenzenes	Vehicle emissions
Phenol	Vehicle emissions
Butenes	Refineries, vehicle emissions

Passive BTEX and Carbonyl Passive Measurements Option

In contrast to the PTR-TOFMS option, the original proposal for this study recommended week-long passive sampling of BTEX (benzene, toluene, ethylbenzene, and xylenes) and carbonyls. This sampling methodology relies on diffusive adsorption of the compounds onto the samplers. Multiple (at least 4 and less than 13) samples would be placed within the Oil Field and surrounding areas. Any spatial patterns in concentrations would be evaluated to determine whether concentrations are higher within and downwind of the Oil Field than in the surrounding areas.

One example of the type of diffusive passive sampler that could be used for benzene is the Radiello 130 sampler. The 130 cartridge is a stainless steel net cylinder, with 100 mesh grid opening and 5.8 mm diameter, packed with 530 ± 30 mg of activated charcoal with particle size 35-50 mesh. Volatile organic compounds are trapped by adsorption and later recovered by carbon disulfide displacement, analysis is performed by flame ionization detection gas chromatography or gas chromatography/mass spectrometry (GC/MS). The selectivity and certainty of chemical identification are substantial benefits of using GC/MS. Also, at environmental concentrations, for which there are more potential interferents, the complexity of the organic mixtures in air can complicate the reliability of a non-GC/MS-based analytical method.

Under this method, passive sampling, parallel in approach to that described above for hydrocarbons, will be used to assess ambient concentrations of carbonyl compounds. Radiello 165 is a stainless steel net cartridge filled with 2,4-dinitrophenylhydrazine (2,4-DNPH) coated Florisil. Aldehydes react with 2,4-DNPH to give the corresponding 2,4-dinitrophenylhydrazones. The 2,4-dinitrophenylhydrazones are then extracted with acetonitrile and analyzed by reverse phase HPLC and UV detection.

We have budgeted a total of 52 BTEX samplers and 52 carbonyl samplers, with 10% of the samples used for quality assurance. The number of samplers to be deployed at one time, and the spatial arrangement of those samplers, would be determined after a few months of meteorological and BC data have been collected. This would allow us to more accurately approximate the spatial extent of the Oil Field impacts of BC, and by inference, the potential for impacts of BTEX and carbonyls. Sample locations would include the four existing monitoring sites for Aethalometers as described in Section 4, and would also include receptor sites in the community downwind of the Oil Field.

Advantages and Limitations of the VOC Measurement Options

Both VOC measurement options are viable methods that can be used to meet some of the monitoring and analysis objectives set forth in the RFP. However, both options are also limited, and neither will meet all of the monitoring objectives. This subsection lays out the advantages of each option, which objectives will be met by each option, and states the objectives that cannot be met by each option.

The PTR-TOFMS option has the advantages of very high time resolution, more sensitive measurement capabilities, more data (~4000 measurements over two weeks), and a larger set of compounds (>20 target species) that will be captured. The biggest limitations of the PTR-MS option are a lack of spatial information and a short two-week field measurement campaign; both are factors of the limited budget. With additional funds from external funding sources, these two limitations could be mitigated by extending the length of the field deployment and performing a mobile monitoring campaign to identify spatial patterns in pollutant concentrations. This option would be better for quantifying air toxics emissions from Oil Field operations, assessing acute risk, distinguishing sources of emissions, and assessing the Oil Field operation contributions to acute risk. Due to the limited deployment time, chronic assessments of health risk would not be possible with this option.

The passive measurement option has the advantages of spatial and seasonal coverage, although this is again limited by the 52 total samples budgeted for. The limitations of this option include insufficient temporal resolution for acute assessment, a limited suite of approximately six target pollutants, less sensitive measurement resolution, and only 52 total samples with which to assess spatial and temporal coverage. Additional external funds could be used to add samples which would be used to extend the spatial and temporal coverage. Additional samples would help our statistical power of analysis, but would not address the other issues associated with the method itself. These week-long measurements may be sufficient to show gradients in concentrations, and thus any potential hot spots, and to show concentrations that are above chronic levels of concern and identify whether additional monitoring of these pollutants on shorter-time scales is warranted. Thus, this option would meet the chronic exposure objective, could potentially identify acute exposure issues if concentrations are very high, and could be used to identify if the Oil Field is an identifiable source of these pollutants over longer time periods. However, this option could not be used to quantify the emissions from the Oil Field, nor would it be sufficient to rule out potential acute exposures from the Oil Field. It is also unlikely to be able to quantify sources of emissions within and around the Oil Field, although it may be able identify sources.

Considering the advantages and limitations of the two options, we recommend the PTR-TOFMS option as the better approach to meet more of the monitoring objectives, despite its limited deployment time. If additional external funding is acquired, the limitations of this option could be partially or wholly mitigated, making it an indisputably better option.

2.2.4 Meteorological Monitoring

A 10-meter meteorological tower will be established adjacent to the trailer housing the XACT 625 and one of the Aethalometers. Average 1-minute data will be collected from all the deployed sensors. Sensors to be deployed include RM Young models:

- 05305V Wind monitor (wind speed/wind direction)
- 41382VC Temperature and RH sensor
- 41342VC Platinum temperature probes at 2 heights (for Delta-T)
- 61302V Barometric pressure sensor
- 70201 Solar radiation sensor

3. Project Personnel

STI has assembled a multi-disciplinary and experienced team of professionals with proven experience on projects similar to this one. A summary of the team's credentials and experience is provided in **Table 3-1**.

Table 3-1. Summary of project personnel and experience.

Name	Title / *Field of Expertise*	Project Role	Highest Degree / Yrs of Experience	So. Cal AQ Exp.
Sonoma Technology, Inc.				
Dr. Paul Roberts	Executive Vice President; Chief Scientific Officer; Corporate Quality Assurance Officer / *AQ/met monitoring, QA/QC*	Principal Investigator	Ph.D., Environmental Engineering Science / 33	✔
Mr. David Vaughn	Group Manager, Air Quality and Exposure Measurements / *AQ/met monitoring*	Project Manager, Monitoring Lead	M.S., Plant Sciences / 23	✔
Dr. Mike McCarthy	Senior Air Quality Analyst / *Exposure Assessment*	Data Interpretation Lead	Ph.D., Chemistry/ 8	✔
Mr. Clinton MacDonald	Group Manager, Meteorological Measurements and Analysis / *AQ/met monitoring and analysis*	Project Advisor for Meteorology	M.S., Atmospheric Science / 16	✔
Ms. Alison Ray	Field Technician / *Monitoring equipment maintenance*	Senior Field Technician	B.S., Business Administration / 21	✔
Mr. Kevin Smith	Field Technician / *Monitoring equipment maintenance*	Field Technician	B.A., Commercial Illustration / 11	✔
University of Massachusetts				
Dr. Rick Peltier	Assistant Professor / Ambient aerosols and human health	XACT 625 instrument support and data analysis	Ph.D., Atmospheric Chemistry / 10	✔
University of Wyoming				
Dr. Shane Murphy	Assistant Professor / Atmospheric Science	PTR-TOFMS 8000 instrument support and data analysis	Ph.D., Atmospheric Chemistry / 4	✔
Mr. Jeff Soltis	Associate Research Scientist/ Atmospheric Science	PTR-TOFMS 8000 instrument support and data analysis	M.S., Soil Sciences and Water resources/5	
Dr. Robert Field	Associate Research Scientist/ Atmospheric Science	PTR-TOFMS 8000 instrument support and data analysis	Ph.D., Atmospheric Chemistry / 17	

4. Critical Monitoring Factors: Siting, Frequency, and Duration

The siting of monitors, and the frequency and duration of sampling, are factors critical to obtaining high quality data with appropriate spatial and temporal resolution for evaluating the Oil Field's contribution to the concentrations of air toxics in the surrounding communities. Because of the complexity of the Baldwin Hills air quality monitoring project (multiple oil field activities generating a number of potential pollutants, meteorology, topography, land area, background concentrations, applicable monitoring methods), these factors require careful consideration.

This section of the DWP discusses the reasons for choosing the selected sites, as well as the frequency and duration of monitoring, with the goal of minimizing cost and maximizing the return of high quality data. Of primary importance is the consideration of diurnal and seasonal meteorological patterns and their impact on the dispersion and transport of air toxics. Local topography and existing obstructions may impact wind patterns and must also be considered. Because the metals monitoring with the XACT 625 and the VOC monitoring with the PTR-TOFMS are both relatively short field campaigns within the context of the year-long study, it is critical that this monitoring be conducted during periods when oil field activities of concern are being conducted. For example, it is likely that there will be no drilling operations occurring at the oil field until January 2013, and drilling operations are expected to be a major contributor to oil-field-derived concentrations of metals in ambient air. If the drilling rig(s) and diesel generators are not operating, the XACT 625 metals monitor would miss the main sources of metals emissions from the Oil Field.

Initial considerations of the overall size and dimension of the Oil Field, and the layout of the communities surrounding the Oil Field, suggested that monitoring in the four cardinal directions surrounding the area would be basic to the sampling design. As a next step in choosing monitoring locations, the available meteorological data from the existing PXP meteorological tower within the Oil Field, as well as data from the SCAQMD’s stations at LAX and at West Los Angeles, were evaluated for diurnal and seasonal wind patterns. (Meteorological characteristics are discussed in detail below.) The potential influences of topography (e.g., canyons), obstructions or barriers (e.g., large trees, buildings, water towers), roadways, and regional demographics were considered. On-site inspections within the Oil Field were then made to identify potential areas for monitoring that met these basic criteria, were accessible, and had or could have electrical power available. On-site evaluations of the communities bordering the oil field were made by physically driving through the neighborhoods. The decision on the number and placement of the monitors was based upon all the above factors, considered in light of official siting criteria for air quality monitoring established by the U.S. Environmental Protection Agency (EPA).

Four sites were chosen to conduct the continuous monitoring. **Figure 4-1** is an aerial view of the Inglewood oil field and neighboring communities. The four sites are shown in this figure, labeled as north (N), east (E), south (S), and west (W). Each of these sites will be equipped with cellular modems allowing sub-hourly data retrieval and remote access to instrumentation for diagnostics and troubleshooting. Site S and Site E are designated as the monitoring sites where the trailer housing the meteorological tower, the XACT 625 semi-continuous XRF spectrometer (continuous metals monitor) and one of the Aethalometers will be sequentially located. These are also the sites where the PTR-TOFMS will be deployed.

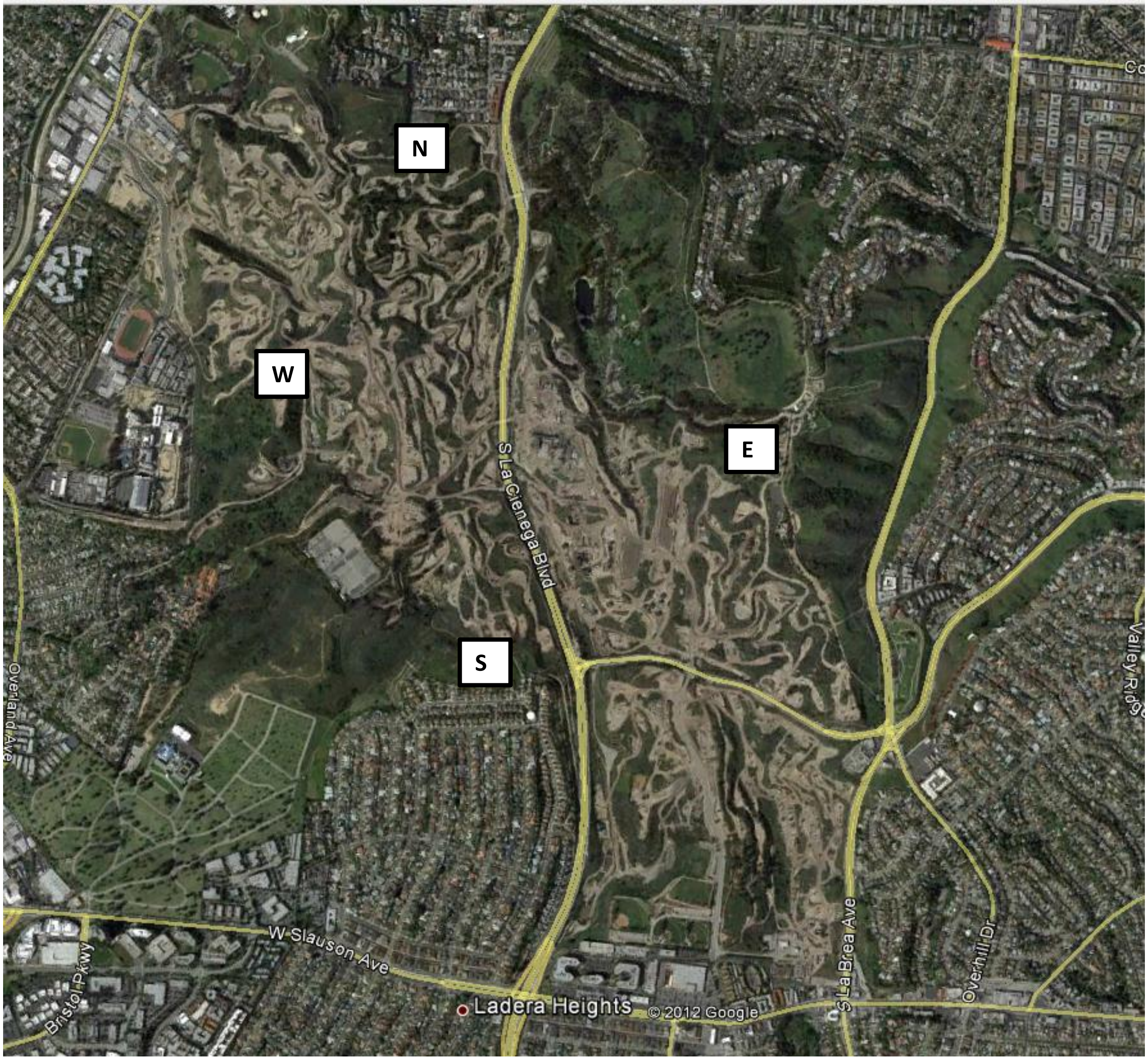

Figure 4-1. Aerial view of the Inglewood Oil Field, showing the locations of the four monitoring sites: north (N), east (E), south (S), and west (W).

Semi-continuous (5-min) black carbon measurements will be made for a full year at all four sites and will adequately represent seasonal effects on concentrations of this surrogate for DPM. Ideally, all parameters would be similarly monitored for a complete year so the effects of seasonal variability on ambient concentrations of the monitored toxics could be estimated. Given the limitations on scope attributable to budget, the frequency of sampling for metals and VOCs must be limited. However, when carefully coordinated with siting, adequate representation of pollutant concentrations can be achieved, since data collected at one site represent both upwind and downwind conditions during times of onshore and offshore wind flows. In summertime, wind flows are primarily onshore, and in wintertime they are primarily offshore. Spring and fall are characterized by mixed wind flow patterns and present an opportunity to conduct measurements under both regimes. It is during the fall and springtime periods that the continuous measurements of metals and VOCs are planned. Sites S and E will be used, sequentially, to host the deployment of the meteorological tower, one of the BC monitors, and the XACT 625 metals monitor. Similarly, the PTR-TOFMS VOC monitor is on a mobile platform and may be deployed at either Site S or Site E, or sequentially at both

The metals monitor is available to this project for a two-month period, and the tentative plan is to have this monitor in place for a two month period between November 2012 and February 2013. This time period was chosen because meteorological conditions during this time period exhibit diurnal patterns that contain both onshore and offshore wind flows and will allow a reasonably complete characterization of Oil Field and other source contributions to neighborhood-scale metals concentrations. The optimal two-month deployment window, based on meteorology, is the November/December time frame. Wind flow patterns are advantageous for monitoring (Figure 4-2, left panel), and this is historically a drier season than, for example, January through March. Rainfall can decrease ambient air metals concentrations through wet deposition processes. However, since drilling operations are, as of this writing, not currently planned until January 2013, the deployment of the metals monitor may be delayed until this work activity resumes. Drilling operations are presumed to be a major oil field-based contributor to ambient metals concentrations.

Not all seasons of the year are favorable for representative air quality monitoring. **Figure 4-2** is a wind rose representation of all hourly wind data collected in November 2011 (left panel) and August 2011 (right panel) from the SCAQMD-sanctioned meteorological tower located within the Oil Field. These data are considered typical for these time frames in Los Angeles. The November data show clearly that the dominant wind directions are from the southwest and the northeast, offering the potential to sample during both onshore and offshore flows. This is in contrast to the August data, where wind flows are mostly onshore. Offshore flows are infrequent during summer months, limiting the potential for sampling under the two major wind flow regimes. Wind patterns during January and February are similar to those in November and December, with a mixture of onshore and offshore flows. If the timing of drilling operations dictates that the metals monitoring occur in January and February of 2013, diurnal onshore and offshore wind flow will still allow representative sampling, but the chances of rainfall are higher in those months.

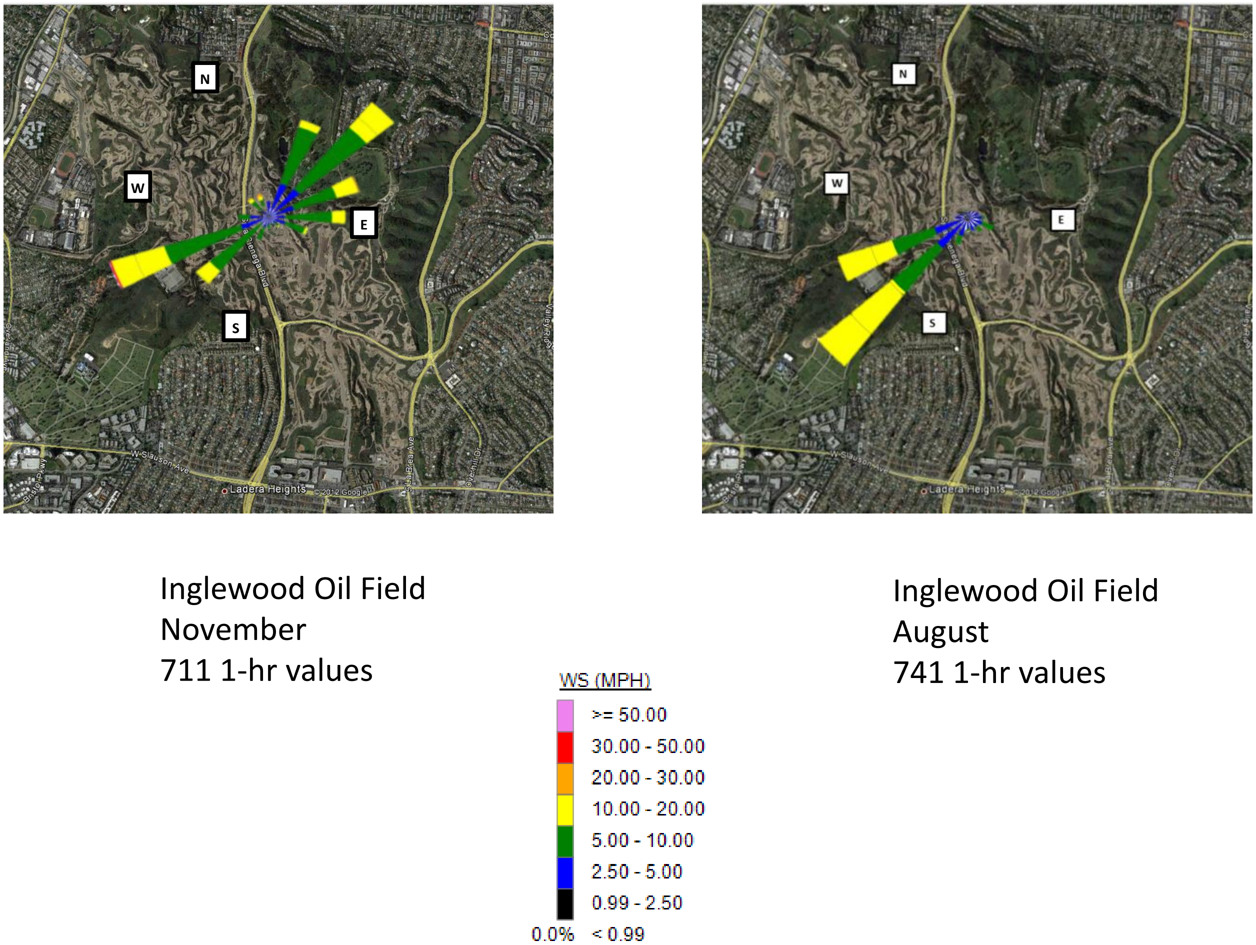

Figure 4-2. Wind rose diagram of hourly averaged wind speeds measured at the Inglewood Oil Field during November 2011 (left panel), and during August 2011 (right panel). Rose petals point toward the direction the wind is coming *from*.

Figure 4-3 is derived from the same data set of November 2011 shown in the left panel of Figure 4-2, but the wind data are divided into four time periods of the diurnal cycle, representing nighttime flows, daytime flows, and periods of mixed flows. This distribution of wind directions during the diurnal cycle, combined with a dual siting approach for the metals monitoring (discussed below) affords the opportunity to measure pollutant concentrations both upwind and downwind during onshore and offshore flow regimes. The wind rose in the upper left panel shows that wind directions from midnight to 7:00 a.m. are predominantly offshore, emanating from the northeast. The lower right panel shows that daytime flows from 1:00 p.m. to 7:00 p.m. are from the opposite direction, strongly onshore. The other two periods, representing the 7:00 a.m. to 1:00 p.m. period (upper right) and 7:00 p.m. to midnight (lower left) show that wind patterns are more mixed as conditions change from onshore to offshore, or vice versa.

During the first month of the two-month metals sampling campaign, the XACT metals monitor will be situated at Site S. During times of nighttime offshore wind flow in November (Figure 4-3, upper left), the monitor will include the contribution of the Oil Field, but also the regional contributions from areas upwind of the Oil Field to the northeast (downtown Los Angeles). During times of daytime onshore flow while at Site S (Figure 4-3, lower right), the monitor will measure regional concentrations from upwind sources to the southwest. During the second month of metals monitoring, the trailer will be moved to Site E, on the other side of the Oil Field, and will yield a parallel, but somewhat mirror-imaged, data set. Here, during times of onshore wind flow, the monitor will be downwind of the Oil Field and measuring Oil Field contributions combined with those from regional upwind areas to the west. During nighttime (offshore flow, Figure 4-3, upper left) only regional contributions would be measured at Site E. During the periods of the day when wind directions are more mixed (Figure 4-3, upper right and lower left), the same monitoring concepts apply, with the caveat that the metals monitor is anticipated to operate by reporting 15-minute average values, so the chance of variable wind directions (logged with 1-minute averages) falling within a given 15-minute sample is higher, making source identification less certain. This same monitoring approach is to be applied to the VOC sampling with the PTR-TOFMS.

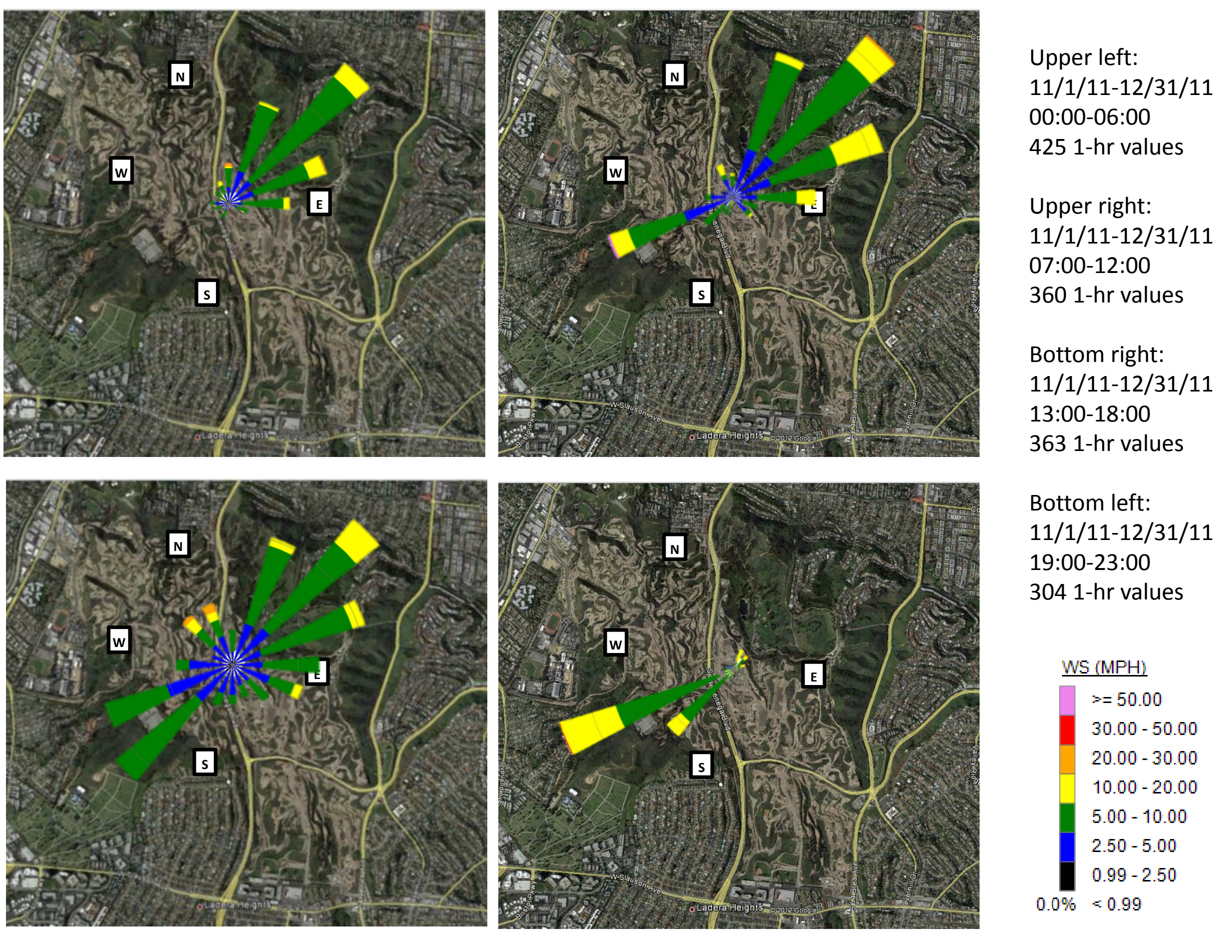

Figure 4-3. Average hourly winds measured at the Inglewood Oil Field during November 2011, broken into four periods, showing the patterns of diurnal variation. Time values show the begin hour.

The trailer will also host a tower with a full complement of meteorological instrumentation reporting 1-min averaged data. The highly temporally resolved meteorological data, when paired with the semi-continuous measurements of BC, metals, and VOCs at Sites S and E, will allow estimation of pollutant concentrations both upwind and downwind of the oil field during daytime onshore wind flows, and upwind and downwind of the oil field during nighttime offshore wind flows.

When combined with time/location activity data for drilling operations and well work-overs, these data sets will address the primary study objectives of estimating the air toxics emissions from the Oil Field operations and assessing the health risk of both acute and chronic exposure to air toxics emissions from Oil Field operations. This approach will also provide data for the secondary objectives of distinguishing the major sources of toxic air emission within the areas surrounding the Oil Field and assessing the Oil Field's contribution to the overall acute and chronic health risk in the areas surrounding the Oil Field

5. Oil Field Operational Data

Of critical importance to fully addressing the study objectives is the documentation of time/location activity information for major Oil Field operations. Topping this list of activities are well drilling and well work-overs.

Drilling operations are fairly distinct episodes, with a maximum of two drilling rigs operating at any one time. Drilling occurs during regular hours (7:00 a.m. to 7:00 p.m.) and the rigs are usually stationary for 4 to 6 days. Thus, documentation of drilling should not be complicated.

On the other hand, well work-overs occur at multiple locations simultaneously and are less easy to document. STI has verbal commitments from PXP to devise and set up a mechanism for documenting and reporting drilling and well work-over operations.

6. Quality Control and Quality Assurance

The terms "quality control" (QC) and "quality assurance" (QA) are often used interchangeably, but in fact have important distinctions. Quality control refers to the operational techniques and activities used to fulfill the requirements for quality. QC is what the field technician practices when conducting maintenance and verification procedures on the API-633 Aethalometer or the XACT 625 spectrometer, for example. QA refers to the planned or systematic activities used to provide confidence that the requirements for quality are fulfilled. For example, post processing data validation protocols are QA activities. Day-to-day QC activities are described below.

The first line of defense against invalid data is the implementation of best practices in day-to-day QC operations affecting the data collection process. Major QC and QA practices are outlined below, with specific details as they relate to the Baldwin Hills project. Several embedded Quality Control procedures for the API 633 Aethalometer, the XACT 625, and the PTR-TOFMS instruments have been explained along with the instrument descriptions (above).

- **Understanding of the principle of operation of the equipment.** STI's project team has extensive experience with Aethalometers. STI is frequently asked to beta test new versions of instrument hardware and software. Dr. Peltier is an expert user of the XACT 625 spectrometer, and Dr. Murphy is an expert user of mass spectrometry.
- **Diligence in site selection followed by strict installation procedures.** During the site selection process, EPA guidelines for site selection for meteorological instrumentation were followed. Selection of the monitoring sites was based upon topography, winds, accessibility, and pertinence to project objectives. Proper installation includes such factors as electrical grounding, leak checking, sampling fetch, enclosure stability, and level (plumb).
- **Co-located intercomparison of Aethalometers.** The four T-API Model 633 Aethalometers will be co-located for one to three days prior to initial deployment to document any between-instrument bias. This procedure will be repeated at the end of the study. If time and budget allow, a mid-year co-located comparison will be conducted as well.
- **Canister sampling of VOCs.** During the deployment period of the PTR-TOFMS, 24-hour Summa canister samples for VOCs will be obtained on the 1-in-6 day EPA sampling schedule, and subjected to TO-15 analysis. This will provide a cross-check against the continuous PTR-TOFMS and the simultaneously collected samples for the MATES IV program (which is currently under way).
- **Scheduling and implementation of routine maintenance procedures** (e.g., inlet cleaning, pump maintenance). The Aethalometers and the XACT 625 will undergo monthly cleaning procedures. Tape changes of the Aethalometers and the XACT 625 will occur as needed. The tower and cabling of the meteorological installation will be reviewed at each site visit.
- **Scheduling and implementation of routine QC protocols** (e.g., flow checks, blank calibrations, calibrations, instrument settings). Flow checks will be conducted monthly on the Aethalometers and the XACT 625. Daily QC checks on four reference elements will be conducted with the XACT instrument. Blank calibrations will be conducted hourly on the PTR-TOFMS. Additionally, a detailed gas calibration using a traceable standard will be performed at the beginning of the deployment on the PTR-TOFMS. Field gas calibrations will then be performed at least once every three days for the duration of the deployment.
- **Regular audits.** Meteorological equipment will be audited at installation, at six months, and at the end of the field study. Aethalometer flow rates will be audited monthly.
- **Documentation/reporting of all field QC results and related field activities.** All field QC procedures will be documented in a digital log of the Data Acquisition System at the main trailer at Sites S or E. Notebooks will be kept at the BC-only sites for documentation of tasks performed at each site visit. Originals and copies of the documentation forms for the passive samplers will be housed separately.

- **Daily review of real-time data via a central data system.** Aethalometer and XACT 625 data will be polled sub-hourly and posted on a real-time web page for daily, or more frequent, review.

- **Prompt troubleshooting of any observed operational problem.** Operational problems will be addressed as soon as site visit arrangements are cleared with PXP.

The documentation methods differ between the semi-continuous sampling protocols (Aethalometer for BC, XACT 625 XRF spectrometer for metals, and PTR-TOFMS for VOCs) and the passive samplers used optionally to assess the ambient concentrations of BTEX and carbonyl compounds.

The continuous monitors incorporate in their firmware several automatic documentation protocols that reveal instrument performance characteristics. In the case of Aethalometer measurements for BC, the instrument records not only the BC concentration, but also data for a number of instrument diagnostic variables, such as reference and sample lamp voltages and flow rates. Flow rates are checked monthly by a field technician using a certified NIST-traceable reference flow meter and are recorded in a log book. Any measured flow rate that is more than 5% outside the target flow rate is corrected by performing a flow calibration on the instrument using an internal flow calibration routine in combination with the reference flow meter. The trailer location will also have a digital log book as part of the Data Acquisition System (DAS), and the field technician will record all field activities there so that they may be reviewed remotely by the project manager. Daily review of the BC data plays a significant role in the documentation of instrument performance.

The optional use of passive samplers for measurement of ambient concentrations of VOCs and carbonyl compounds relies on adherence to specific protocols for sample setup, exposure, retrieval, storage, and shipping, accompanied by accurate record keeping by the field technicians. Specific protocols, provided by the sampler manufacturers, will be followed. For record keeping, two main types of information are required for tracking the samples: Chain of Custody (COC) information and Site Identification information. An example of a COC form is shown in **Figure 6-1**. The COC form allows for documentation of important sampler data and helps to track samples as they are deployed to the field and then sent on to the laboratory for analysis. The Site Identification form helps to document important information about each monitoring site, including photos of the sites and notes on accessing the site. An example is shown in **Figure 6-2.** These forms were developed by STI and EPA staff and used for the recent NO_2 near-road pilot study (http://www.epa.gov/ttn/amtic/nearroad.html).

If passive sampling is performed, at least 10% of the collected samples will include a duplicate sample. The analytical laboratory will be required to perform method blank checks for each batch of samples analyzed. Blanks above the method detection limit will be flagged and rerun for all key species. Additionally, individually samples will be spiked with a tracer species to ensure that the tracer is recovered to within +/- 30%. Finally, replicate calibrations of key species will be required to be within 30% to ensure reproducibility of sample results.

A summary of major quality control and quality assurance activities is provided in **Table 6-1**.

Passive Sampling Device (PSD) Chain of Custody Form			
Field Log			
PSD ID		**PSD receipt date (optional**	
Substrate information	☐ BTX	☐ Carbonyl	
Type of use	☐ Sample	☐ Field Blank	☐ Trip Blank
Site name ____ **PSD mount no.** ____ **Latitude** ____ **Longitude** ____ **PSD mount height (m)** ____		**Exposure date and time (mm/dd/yy hh:mm)** **Recovery date and time (mm/dd/yy hh:mm)**	
Field notes			

Chain of Custody Log	
Shipping Information	
Shipped to lab by	**Date**
FedEx tracking number	

Lab Receipt Information (Lab Use Only)	
Received at lab by	**Date**
Condition of container/PSDs	

Figure 6-1. Example of a Chain of Custody form.

Site Information Sheet

Baldwin Hills Passive Sampling

Site name

Site address

Site access and safety (including entry/egress points and any suggested or required safety procedures)

Passive Sampling Device (PSD) Mount Information

PSD Mount 1

Latitude ______________________

Longitude ______________________

PSD mount height (m) ______________

Miscellaneous information:

PSD Mount 2

Latitude ______________________

Longitude ______________________

PSD mount height (m) ______________

Miscellaneous information:

(Continue on subsequent page if necessary)

Figure 6-2. Example of a Site Identification form.

Table 6-1. Summary of major quality control and quality assurance activities.

Quality Control/Quality Assurance Protocol	Instrument/Parameter: Teledyne-API 633 Black Carbon Monitors	XACT 625 Metals Monitor	PTR-MS VOC monitor	Meteorological Sensors	Passive BTEX/Carbonyl	Shelter Temperature
Daily review of data and diagnostics, clock checks	✔	✔	✔	✔		✔
Periodic flow checks against NIST-traceable reference	✔	✔	✔			
Standardized reference checks (hourly, daily)		✔	✔			
Routine monthly maintenance (e.g., visual inspection, tape changes, inlet cleaning, pump maintenance)	✔	✔	✔	✔		✔
Documentation by manual log notes (each site visit)	✔	✔	✔	✔	✔	✔
Meteorological sensor audits (at install, 6 months, removal)				✔		
Co-located intercomparison of the four T-API Model 633 Aethalometers	✔					
24-hr 1-in-6 day VOC sampling			✔		✔	

The responsibility for implementing the Quality Control Plan rests primarily with the Project Manager, David Vaughn. Mr. Vaughn will manage and direct the financial and staff assets of the project to provide quality work products on schedule and within budget. He is responsible for communication with the client, Principal Investigator, Senior Advisor, task leaders, staff, subcontractors, and line managers regarding the project. He is also responsible for monitoring progress in relation to project milestones and proposing corrective actions if the milestones are not being met on schedule or within budget. Mr. Vaughn will work with the Principal Investigator to ensure that technical objectives are met.

The Project Manager is responsible for all aspects of the project from preparing the initial work plan to ensuring the final invoice is sent. As Project Manager, Mr. Vaughn

- Directs project staff, communicates the context of assignments, and holds project staff accountable for quality and timeliness
- Manages project-related communications with the client, Principal Investigator, Senior Advisor, task managers, staff, subcontractors, and line managers
- Monitors project progress in relation to milestones and budget and proposes corrective actions if the project falls behind

- Ensures
  - Adequate funding has been allocated for quality management including senior review
  - Project deliverables are entered into STI's tracking system
  - Staff assigned to the project use STI best practices, including templates and review process to ensure work products meet quality standards
  - Work products are prepared, reviewed, and delivered to the client on schedule
- Works out scope changes with the client and staff assigned to the project
- Communicates, explains, and may document the technical approach, methodology of the project, project results, and conclusions
- Negotiates to find acceptable solutions in cases of conflicts with budget, staffing, or schedule, in cooperation with the Principal Investigator and guidance from the Senior Advisor as needed
- Keeps the Principal Investigator and Senior Advisor advised of project status on a regular basis

7. Data Analysis and Reporting

7.1 Data Analysis

Data analysis will occur in three phases. In the first phase, measurements will be examined daily by trained analysts as part of the QA data validation step. This will ensure that any problems with measurements will be identified early and be remediated before data quality is impaired. Additionally, the data analysts will become familiar with the temporal and spatial patterns in the black carbon data early in the project. With regards to the metals and VOC measurements, these data will also be reviewed on a daily basis and compared to the black carbon data so we can begin identifying commonalities and differences in the key toxics of concern.

In the second phase of data analysis, the STI team will perform interim analysis of monitoring data to begin examining results with regards to meeting the project objectives. These interim data analyses will occur at least quarterly for the Aethalometer measurements, and will occur at the halfway point of the metals and VOC measurement deployments. In the interim analysis, STI analysts will begin to quantify air toxics emissions originating from the Oil Field and assess the acute and chronic health risk of those pollutants. For the BC measurements, STI will perform the following analyses.

- Compare time series measurements of BC at all sites to determine spatial pattern
- Examine distributions of BC at each site binned by wind speed and wind direction
- Examine pollution roses of BC concentrations at each site to determine whether the Oil Field contributes to highest local concentrations
- Compare downwind-upwind site paired hourly concentrations to determine Oil Field contributions.

- Compare monthly average BC concentrations to California chronic cancer and noncancer dose-response values.
- Compare the estimated Oil Field contribution of monthly average BC concentrations to California chronic cancer and noncancer dose-response values

For the XACT metals and proposed PTR-TOFMS measurements of VOCs, only a single measurement device is available and only for a short period of time. Thus, spatial comparisons and longer-term comparisons will not be as appropriate. Instead, the greater number of chemical species and the correlations with wind speed and direction will be used to attempt to identify distinct sources of toxic pollution. For these measurements, the following interim analyses will be performed.

- Examine time series measurements of key toxics and tracer species to determine temporal patterns that may be associated with specific source activity
- Examine distributions of key toxics and tracer species binned by wind speed and wind direction to assess whether the Oil Field is associated with higher concentrations
- Examine pollution roses of key toxics and tracer species to determine whether the Oil Field contributes to highest local concentrations
- Examine correlations using scatter plot matrices or positive matrix factorization for key toxics and tracer species to identify common emissions sources
- Screen hourly average and 8-hour average concentrations against acute California RELs to identify any acute risks among toxic pollutants
- Screen monthly or weekly average concentrations against chronic California cancer and noncancer RELs to identify any chronic risks

If the passive sampling measurement approach is chosen, STI will use the first two weeks of samples to examine spatial patterns in concentrations among the sites and examine whether the Oil Field appears to be associated with higher concentrations of any of the air toxics measured. Additionally, STI will compare concentrations to acute and chronic screening levels to determine whether any of the key toxics species are above levels of concern.

Upon completion of the interim analyses, Dr. McCarthy will communicate results with the site operators, project manager, and principal investigator. Any data quality issues or remedial actions for the monitoring measurements will be discussed.

Upon completion of the monitoring deployments, STI analysts will perform all of the same analyses with the final data sets to attempt to quantify the Oil Field contributions to each of the key pollutants and to assess the acute and chronic health risk associated with Oil Field emissions. Identifying the Oil Field contributions will be more direct and defensible if accurate documentation of time/location activity data within the Oil Field is made available by PXP. STI analysts will complete the metals and VOC analysis within three months of completion of the deployments. For the black carbon measurements, STI analysts will finalize the analysis before completion of the draft report in January 2014.

Documentation of the analysis results will be provided in the draft and final reports. For each of the key species identified in the proposal, STI will document the Oil Field contribution, if any, the certainty in the result, and the acute and chronic risks associated with that Oil Field contribution, if any. STI will also provide the acute and chronic risks associated with the urban background concentration of each of the same pollutants, and identify any other major emissions sources that contribute to that urban background that were identifiable as part of the study.

Additionally, to the extent feasible given the monitoring data, STI will attempt to distinguish major sources of toxic air emissions within the Oil Field. This will be a more qualitative exercise, as it may not be possible to distinguish mobile sources such as drilling rigs, diesel generators, and other on-site equipment. However, if individual sources such as well, storage tanks, and heavy equipment are identifiable, we will identify these in the report.

7.2 Reporting

The STI team will prepare a draft and final report that includes the following sections.

- An executive summary that summarizes the study and the results, focusing on the project objectives
- An introduction that provides the reader background information on the need for the study, and outlines the contents of the report
- A description of the study methodology, monitoring, timeline, and analysis methods
- The results of the study
- Discussion of the results with regards to the project objectives
- A list of references used for the study
- A list of preparers who were involved in conducting and preparing the study

STI will deliver the draft report in January 2014. Upon delivery of the draft report, a member of the STI team will schedule a meeting to discuss comments and results. The County will have one month to prepare up to 60 written comments on the draft report. The STI team will address the comments and deliver the final report within three weeks of receiving the comments. STI will then schedule a final meeting with CAP to present the results of the study to the community in March 2014.

8. Milestones and Deadlines

Table 8-1 shows the schedule of tasks and deliverables for STI to meet the objectives of the Baldwin Hills Air Quality Monitoring Study. Note that the routine monthly maintenance visits and monthly progress reports are not listed in the table. Progress reports will be delivered by the tenth day of each month. Since the Notice to Proceed was received from Los Angeles County on June 19, 2012, the first report was delivered July 17 (before submittal of this Draft Work Plan).

Table 8-1. Schedule for Baldwin Hills Air Quality Monitoring Study.

Page 1 of 2

Task or Deliverable	Notes	Due Date
Develop draft work plan (DWP, this document) and submit to County and SCAQMD for review		Thursday, July 19, 2012
Address County and SCAQMD comments on DWP and present the DWP to the Community Advisory Panel (CAP)		Thursday, August 23, 2012
County consolidates CAP comments on DWP and delivers to STI		Friday, August 31, 2012
STI finalizes and delivers the final work plan (FWP) to the County		Friday, September 14, 2012
County approves FWP and STI begins implementation of FWP	STI works with PXP to finalize site access procedures/routines, and delivers the enclosures and trailer to the four sites that were selected on April 25, 2012; trailer leveled, anchored, and met tower installed	October 2012
Electrical (power) infrastructure is finalized at the four selected sites N, S, E, and W	Two sites (sites S and E) will have 110/220V, 50A single phase power to accommodate trailer.	October 2012
First quarterly in-person meeting; install meteorological trailer with Aethalometer at site S and Aethalometer enclosures at other three sites and begin monitoring; establish data communications and finalize website		November 2012
Conduct preliminary data analysis to inform the spatial and temporal characteristics of the passive sampling arrays; initiate logistics for siting of winter season VOC and carbonyl passive sampling	This Task is required only if the passive VOC sampling option is selected over the recommended PTR-TOFMS option.	December 2012
Install XACT metals monitor at Site S. If passive VOC option is chosen, then install cool season VOC and carbonyl passive sampling arrays	Some passive sites may require cooperation of community members	January 2013
Collect cool season VOC and carbonyl passive sampling arrays and analyze	Only required if passive VOC/carbonyl sampling option is selected	one week after installation
Second in-person quarterly meeting; move XACT metals monitor to Site E		February 2013
Install high time resolution PTR-TOFMS VOC monitor at Site E or Site S. If passive sampling alternative is used, then install warm season VOC and carbonyl passive sampling arrays	The PTR-TOFMS is the recommended option for the VOC and carbonyl sampling	Spring/Early Summer 2013
Collect warm season VOC and carbonyl passive sampling arrays and analyze	Only required if passive VOC/carbonyl sampling option is selected	one week after installation
Third in-person quarterly meeting;		May 2013

Table 8-1. Schedule for Baldwin Hills Air Quality Monitoring Study.

Page 2 of 2

Task or Deliverable	Notes	Due Date
If passive sampling for VOC/carbonyl is used, then lab analyses of BTEX and carbonyl samples should be complete		June 2013
Interim analysis of metals data, VOC data, and carbonyl data with meteorology and Oil Field time/location activity data under way		August 2013
Fourth in-person quarterly meeting		August 2013
Monitoring complete		November 2013
Data analysis complete		January 2014
Draft Report		January 2014
Draft Report meeting		January 2014
Receive final comments on Draft Report		February 2014
Final Report		February 2014
Final Report meeting		March 2014
Final CAP meeting		March 2014

9. Project Management Procedures

Regularly scheduled project team meetings. STI's standard practice for field studies is to hold regularly scheduled team meetings at various stages of the work. This study involves several distinct phases with different communication needs. These phases include, for example, (a) a project planning and initiation period, (b) a period when we will operate the equipment, and (c) a period when data analysis is performed and results presented. During the early phases, we will have regular, weekly, internal (STI-only) meetings to discuss equipment deployment and progress. We will also have frequent contact, as needed, with the County's project manager during this early phase. Once we enter the more routine, monitoring phase of the work, we plan to hold regular monthly project meetings with County staff. Once the project begins, we can continue to work with County staff to adjust this schedule as needed. During all work periods, we will also communicate work progress, monitoring anomalies, and other pertinent information.

Note that many of these meetings will occur via telephone in order to provide cost-effective information as frequently as needed.

Monthly reports of progress. We will submit monthly progress reports that accompany our invoices. These reports will summarize the work accomplished during the reporting period and the work expected to be completed in the coming three months, detail costs incurred to date, and identify issues (if any) that need to be discussed or resolved with the County. To supplement the monthly reports, the STI project manager will, as needed, present informal briefings and reviews of work performed to the County.

10. References

California Environmental Protection Agency, 2001. A guide to health risk assessment. Report prepared by the Office of Environmental Health Hazard Assessment, California Environmental Protection Agency. Available on the Internet at http://oehha.ca.gov/pdf/HRSguide2001.pdf.

Caudill M., 2012. Semi-continuous metals monitoring in Ohio industrial communities. Presented at the *National Air Quality Conference, Ambient Air Monitoring, Denver, CO, May 14-17* by the U.S. Environmental Protection Agency, Region 5, Chicago, IL. Available on the Internet at http://www.epa.gov/ttn/amtic/files/2012conference/3BCaudill.pdf.

Jordan A., Haidacher S., Hanel G., Hartungen E., Märk L., Seehauser H., Schottkowsky R., Sulzer P., Märk T.D., 2009. A high resolution and high sensitivity proton-transfer-reaction time-of-flight mass spectrometer (PTR-TOF-MS). *International Journal of Mass Spectrometry* **286**, 122-128 (doi:10.1016/j.ijms.2009.07.005).

Marine Research Specialists, 2008. Final Environmental Impact Report: Baldwin Hills Community Standards District. Final report prepared for Los Angeles County Department of Regional Planning, Los Angeles, CA, by Marine Research Specialists, Ventura, CA, SCH# 2007061133, County Project # R2007-00570, October.

National Research Council, 1983. *Risk assessment in the federal government. Managing the process*, National Academy Press, Washington, D.C. Available on the Internet at http://books.google.com/books?id=FA63gOCVogoC.

South Coast Air Quality Management District, 2008. MATES-III: Multiple air toxics exposure study in the South Coast Air Basin. Final report, September. Available on the Internet at http://www.aqmd.gov/prdas/matesIII/MATESIIIFinalReportSept2008.html.

U.S. Environmental Protection Agency, 1999. Compendium Method IO-3.3: determination of metals in ambient particulate matter using x-ray fluorescence (XRF) spectroscopy. Center for Environmental Research Information, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH, EPA/625/R-96/010a.

Yadav V., Turner J.R., Downs J., Rowles T., 2009. Intraurban variability of ambient particulate matter arsenic and other air toxics metals in St. Louis. Proceedings of the *102nd Annual Meeting of the Air & Waste Management Association, Detroit, MI, June 16-19* (2009–A–370–AWMA).